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Two new cave-dwelling *Larca* species from the South-East of Spain (Arachnida, Pseudoscorpiones, Larcidae)

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Two new cave-dwelling *Larca* species from the South-East of Spain (Arachnida, Pseudoscorpiones, Larcidae). - *Larca lucentina* sp. n. and *Larca fortunata* sp. n. are described from the south-eastern Spanish provinces of Alicante and Murcia. These cave-dwelling species are compared with the other species of the genus, particularly the European taxa. The hypothetical descent of cavernicolous European species from populations of a common ancestor similar to the epigean *Larca lata* (H. J. Hansen) is considered.

Keywords: Pseudoscorpiones - Larcidae - *Larca lucentina* sp. n. - *Larca fortunata* sp. n. - *Larca lata* (H. J. Hansen) - cavernicoles - Spain - Alicante - Murcia.

INTRODUCTION

The genera *Larca* Chamberlin and *Archeolarca* Hoff & Clawson were assigned by Harvey (1992) to the newly established family Larcidae, having previously been placed in the Garypidae. Harvey's decision was based on distinctive differences from the Garypidae, such as the anal plate surrounded by a desclerotised region and sternite XI bearing numerous and small lyrifissures. The genus *Larca* was erected by Chamberlin (1930) and only eight species have been described from Europe and North America (Harvey, 1991; Henderickx & Vets, 2002). Species of this genus are inconspicuous and their habits are little known, but they appear to be rare and vulnerable. The dependence of *Larca lata* (H. J. Hansen), the only widespread European species, on old tree hollows and the decline of suitable habitats due to management (Ranius, 2002) were the reasons to include this species in the Red List of endangered species for Sweden (Gärdenfors, 2000). Up to now, four species of the genus were known for Europe, three of which are cave-dwelling, while the fourth, *L. lata*, is epigean. Relationships among these species and the probable origin of taxon diversity is discussed herein.

Beier (1939) described two species from the Iberian peninsula: *Larca hispanica* and *Larca spelaea*, both known only from caves in Catalonia. Two *L. spelaea* specimens were later studied by Mahnert (1977a). Beier's (1939, 1963) criteria for separating these species were mainly based on the size and proportions of the palps, but Estany (1980) showed that there is an overlap when large numbers of specimens

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are considered, and this led him to propose the synonymy of the two species under the name *L. hispanica*. This species has been considered a relict (Beier, 1969) due to its fragmentary distribution and its restriction to caves. Mahnert (1977b) did not mention it as cavernicolous and Zaragoza (1986) considered it to be troglophilic, whereas Bellés (1987, 1994) qualified it as troglobitic.

Specimens reported under *Larca* sp. by Zaragoza & Sendra (1988) and Zaragoza (1990) from Alicante Province in fact belong to a new taxon, herein described as *L. lucentina* sp. n. By mistake Ruiz-Portero *et al.* (2002) mentioned the synonymized *L. spelaea* from Cueva del Yeso, Sorbas, Almeria; its true identity remains uncertain. In recent years the author and some collaborators have been collecting *Larca* specimens (close to *L. hispanica*) from caves in the provinces of Murcia and Valencia; these will be analysed in a future article. The genus *Larca* is therefore widespread in the eastern and southeastern Mediterranean regions of Spain, from Barcelona to Almeria Provinces, where at least three different cave-dwelling species occur.

The two new taxa described in this article show the most highly evolved degree of cave-life adaptation for the genus and a hypothetical argument for their origin is offered.

MATERIAL AND METHODS

Specimens are preserved in 70% ethanol. Examination was carried out with specimens embedded in glycerol on temporary slide mounts. For better observation of the genital region, some specimens were cleared using 10% potassium hydroxide. Some appendages have been dissected for measurement; the measurements and the number of specimens examined are given in Tables 1 and 2. The average measurements (AM) and average ratios (AR) that appear in Tables 1 and 2 have been calculated by adding the holotype data to those of the specimens of the same sex. AR is calculated using the arithmetical mean of the ratios of the specimens of the same species and sex. Explanation about what measurements and what kind of ratios are used is given in Tables 1, 2 and 3. For the photographs, dried specimens were gold-coated and examined under a HITACHI -SN 3000 N- Scanning electron microscope.

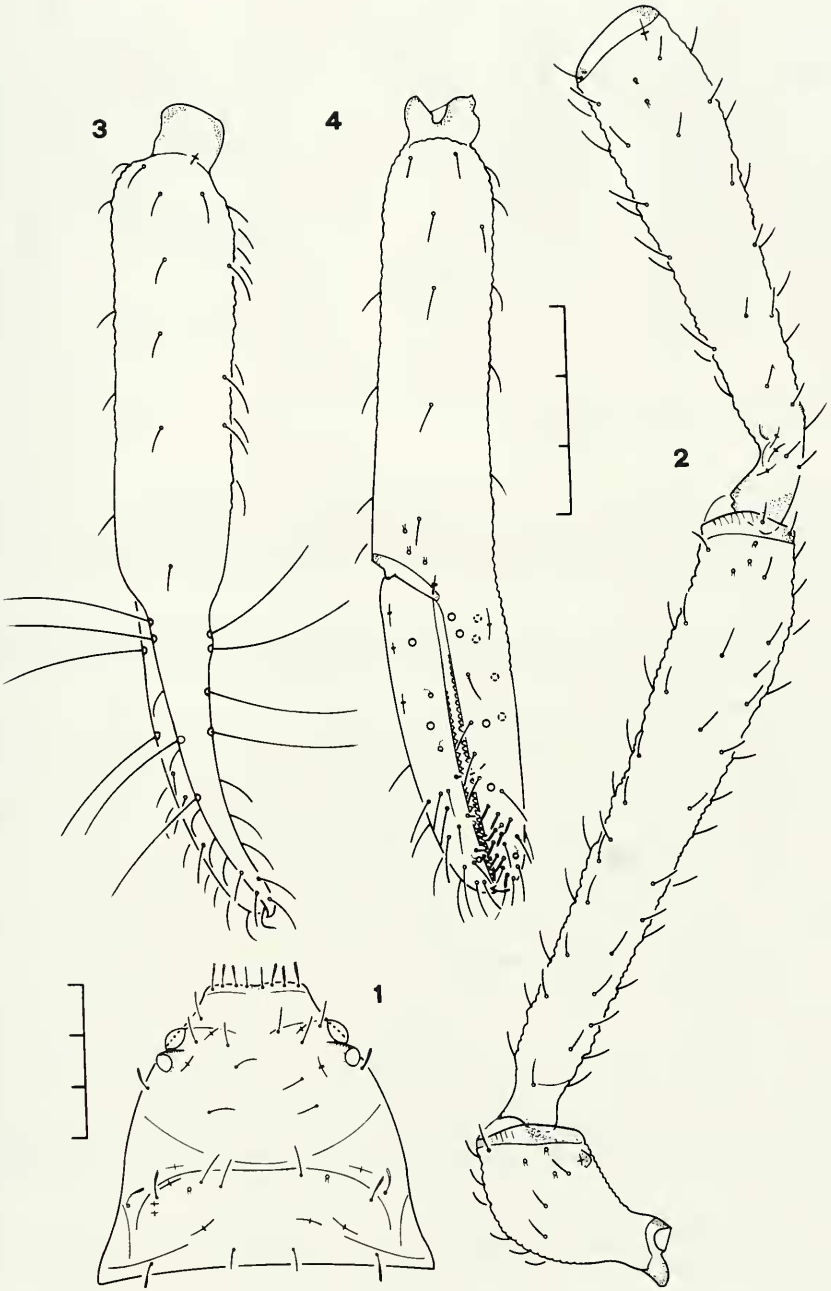
DESCRIPTIONS

Larca lucentina sp. n. Figs 1-6, 12, 13, 16, 18, 20-23

Type material: Male holotype and 24 paratypes (8 ♂♂, 9 ♀♀, 5 tritonymphs and 2 deutonymphs) from Spain, provincia de Alicante, Villena, Sima del Poste, 5 October 1986, leg. J. Pardo and J.A. Zaragoza. 1 ♂, 1 ♀ and 1 tritonymph deposited in Muséum d'Histoire naturelle de Genève; 1 ♂ and 1 ♀ deposited in Muséum National d'Histoire Naturelle, Paris; holotype and remaining paratypes in the pseudoscorpion collection of Departamento de Ecología de la Universidad de Alicante.

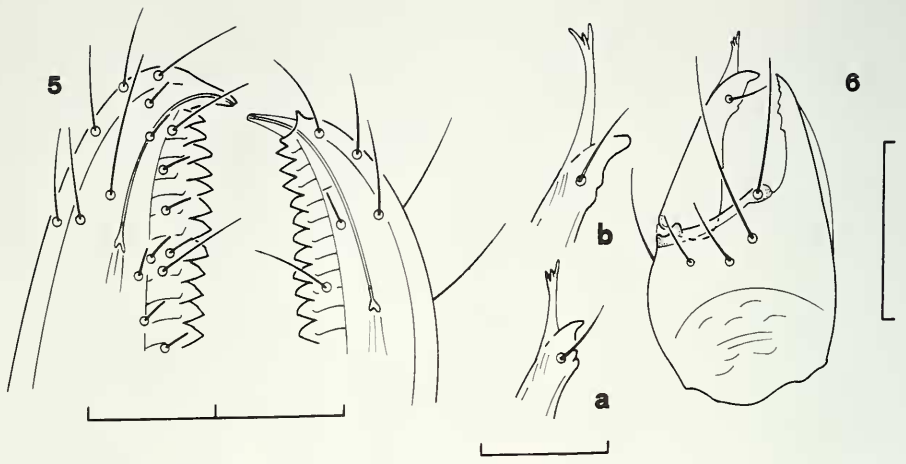
Description of adults

NOTE: Adult paratype data differing from holotype data are given in parentheses.



FIGS 1-4

Larca lucentina sp. n., male holotype. **1** Carapace; **2** Dorsal view of right palp, without chela; **3** Dorsal view of right chela; **4** Lateral view of right chela. Individual scale units = 0.1 mm.



FIGS 5-6

Larca lucentina sp. n., male holotype. **5** Apex of fingers of right chela, lateral view; **6** Left chelicera; **6a** Apex of movable finger with galea. *Larca lucentina* sp. n., female paratype. **6b** Apex of movable finger with galea. Individual scale units = 0.1 mm (Figs 5, 6), 0.05 mm (Figs 6a, b).

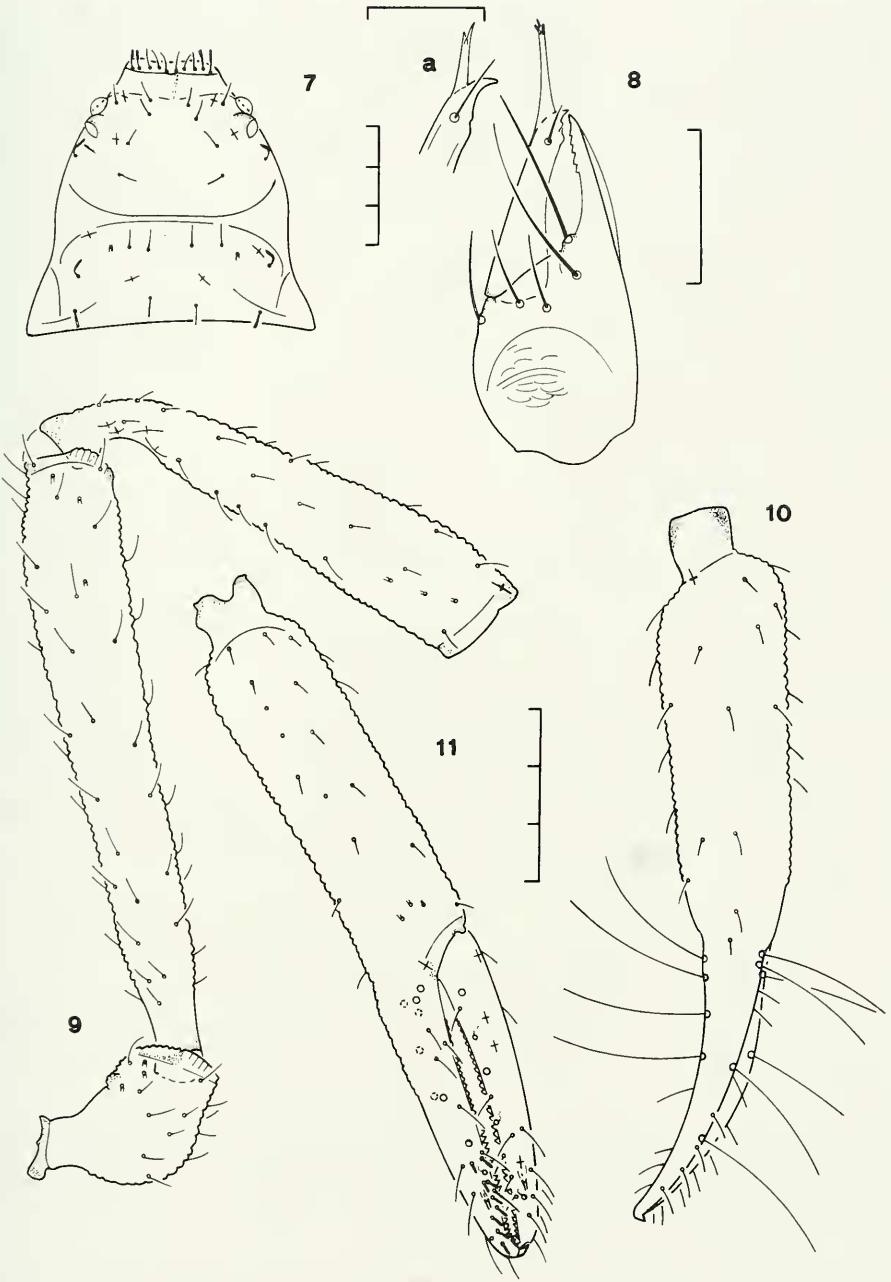
Opisthosomal pleura and legs yellowish, tergites slightly sclerotized. Carapace and pedipalps brownish. Opisthosoma oval, maximum breadth at tergite VI (females clearly broader than males).

Carapace (Fig. 1) granulated, without epistome, broader than long. Two pairs of eyes, anterior eyes situated 0.08 mm (0.10-0.11) from anterior margin, with lens 0.05 mm (0.06-0.07) long and 0.03 mm. (0.02-0.04) broad; posterior eyes raised on a low tubercle with flattened 0.03 mm (0.03-0.04) long lens. Chaetotaxy: 31 (27-36), with 8 (8-10) setae at anterior margin, 12 (10-14) in anterior region delimited by well-marked median furrow, 7 (6-10) in posterior region between median and posterior furrows, and 4 (1-4) at posterior margin. Anterior and lateral setae curved and apically enlarged, others simple. Some lyrifissures and glandular pores present, as shown in figure 1.

Tergal chaetotaxy I-X: 6 : 9 : 7 : 10 : 9 : 9 : 10 : 10 : 9 : T7T (4-6 : 6-7 : 6-10 : 8/10 : 8-10 : 8-11 : 10 : 8-11 : 9-11 : T6-7T), all tergites divided with exception of tergites I and X, these undivided, tergite IX only divided in distal 1/3. All tergites with granulation, tergites VIII-X showing denticulation. Some lyrifissures present, aligned between setae. Microlyrifissures (gland pores, according to Judson & Legg, 1996) horseshoe-shapes ("ferro di cavallo", Gardini, 1983), present on distolateral corners of tergites I-X: 2-3 : 2-3 : 2-3 : 3-4 : 4-5 : 5-6 : 4-4 : 4-5 : 4-5 : 3-3 (0-2 : 1-2 : 2-3 : 3-4 : 3-7 : 4-5 : 4-5 : 2-6 : 2-5 : 3-3).

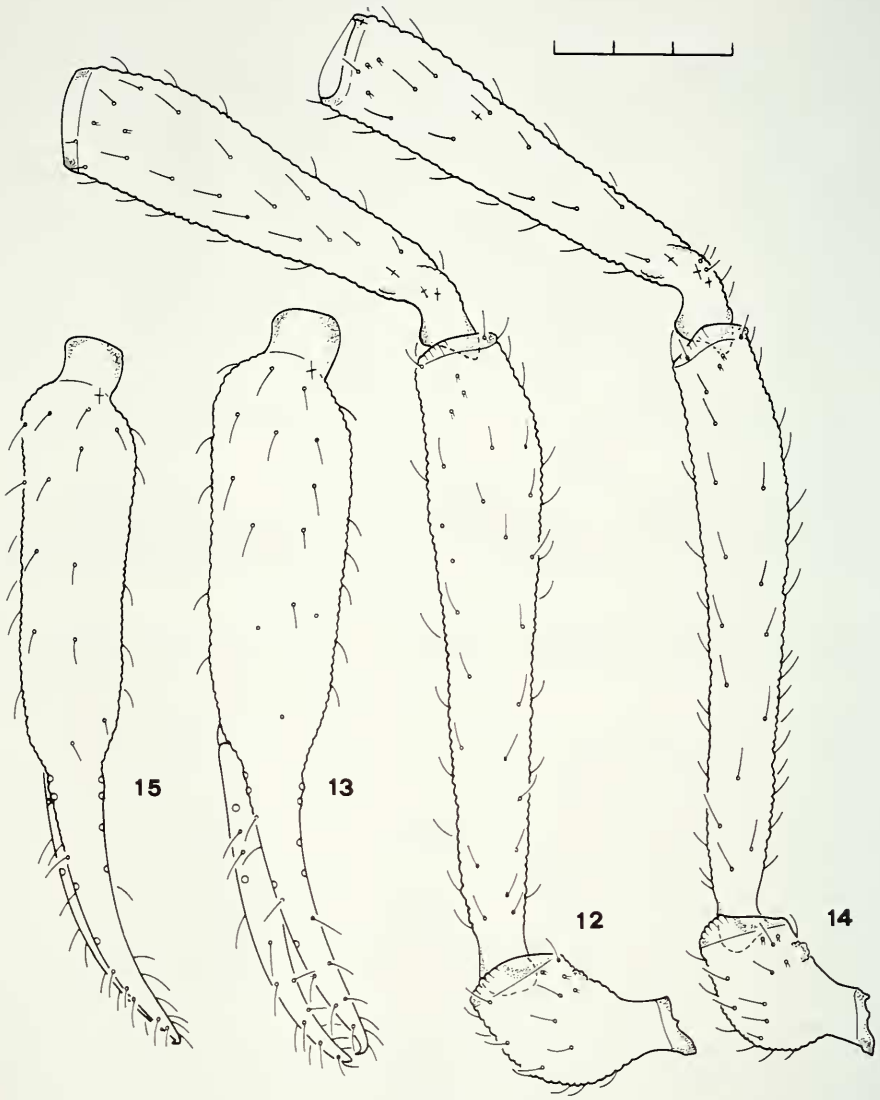
Manducatory process with 3 setae (3-4); palp coxa with 11-12 setae (7-14), pedal coxae with 7-8 setae on coxa I (5-10), II: 8-10 (6-12), III: 9 (7-12), IV: 14-15 (12-19).

Male genital opercula as shown in Fig. 18, with 22 (15-17 in male paratypes) setae on anterior sternite and 28 (23-26) on posterior sternite, median setae in two rows; genital opening with 2+2 (2+3) internal setae. Female genital opercula as shown



FIGS 7-11

Larca fortunata sp. n., female holotype. **7** Carapace; **8** Left chelicera; **9** Dorsal view of the left palp, minus chela; **10** Dorsal view of left chela; **11** Lateral view of left chela. *Larca fortunata* sp. n., male paratype. **8a** Apex of movable finger with galea. Individual scale units = 0.1 mm (Figs 7, 8, 9, 10, 11), 0.05 mm (Fig. 8a).

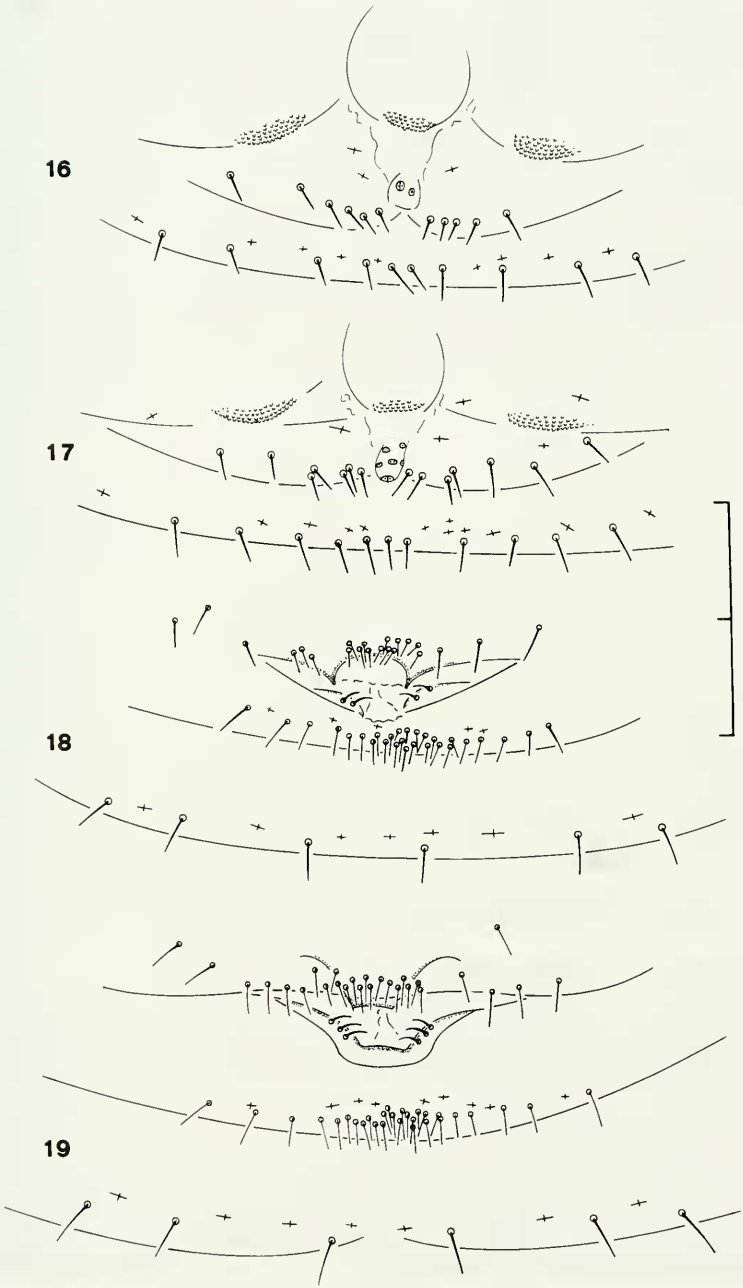


FIGS 12-15

Larca lucentina sp. n., female paratype. **12** Dorsal view of right palp, without chela; **13** Dorsal view of right chela. *Larca fortunata* sp. n., male paratype. **14** Dorsal view of right palp, without chela; **15** Dorsal view of right chela. Individual scale units = 0.1 mm.

in Fig. 16, with 11-15 setae on anterior sternite (some external setae and two median groups of 4-5 setae), posterior sternite with 10/15 setae; three slightly sclerotized cribriform plates in a transverse row, median plate smaller than the laterals.

Sternite IV partially divided, V-VIII divided, IX-X undivided. Chaetotaxy IV-X: 6 : 10 : 9 : 9 : 8 : 8 : 7 (5-7 : 8-11 : 8-12 : 7-10 : 8-11 : 8-10 : 8-9). Sternite XI with



FIGS 16-19

Larca lucentina sp. n. Genital opercula: **16** female paratype; **18** male holotype. *Larca fortunata* sp. n. Genital opercula: **17** female paratype; **19** male paratype. Individual scale units = 0.1 mm.

desclerotised region surrounding anus (Gardini, 1983; Harvey, 1992) and bearing 8 external and 8 internal setae (7-10 + 5-8). Anal plate with 2+2 setae. Some microlyrifissures (as defined for tergites) present on sternites V-XI: 0-1 : 3-4 : 3-3 : 3-3 : 3-4 : 3-3 : 17 (1-1 : 2-5 : 3-4 : 3-4 : 2-3 : 2-4 : 15-20). No setae associated with spiracles.

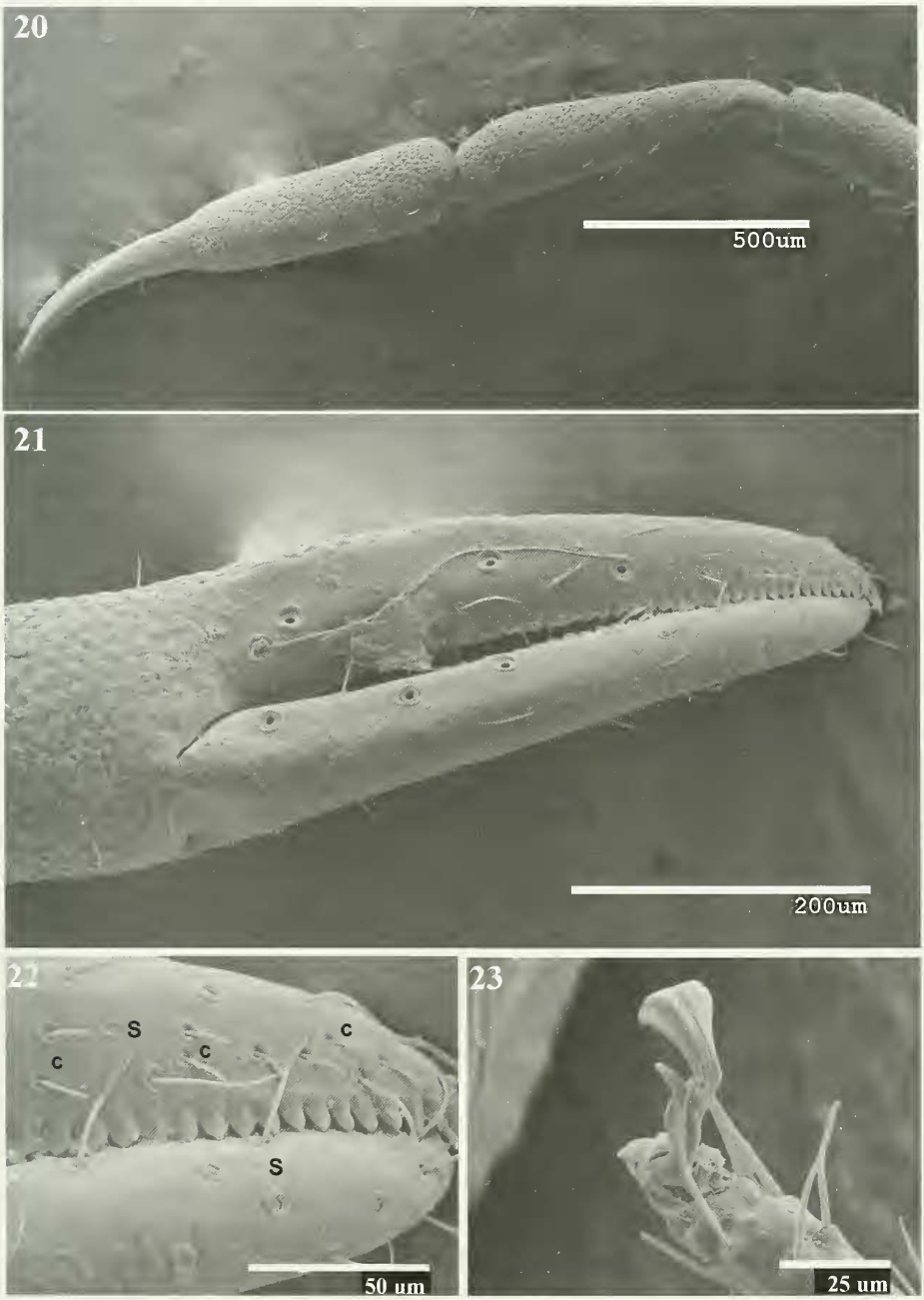
Chelicera (Fig. 6) with 5 setae on hand and 1 seta on movable finger, the latter 0.84 (0.83-0.86) from base. Galea long (Fig. 6a), with 3 (3-4) apical rami, in females longer (0.06-0.08 mm) (Fig. 6b) than in males (0.04 mm). Fixed finger with 2 (1-3) tiny subterminal denticles and 3 (2-4) small teeth; movable finger with 2 rounded subterminal denticles up to the level of seta *gs*. Lamina exterior thin. Flagellum with 4 (3-4) blades, anterior blade with 8 (5-9) spinules, others smooth. Serrula exterior with 16 (15-16) blades. Serrula interior with 10 (10-11) blades, the 3 anterior ones slightly denticulate.

Palp (Figs 2, 3, 4) strongly granulated, except for smooth distal 2/3 of fingers palps. With marked sexual dimorphism, less slender in females (Figs 12, 13). Measurements and ratios in Table 1. Trochanter internally with a small subdistal tubercle and 3 (2-3) micropores. Femur with 3 (2-3) distal micropores. Patella with 3 lyrifissures near pedicel close to a small internal tubercle and 2 distal micropores. Hand laterally with 3 micropores at base of finger. Fixed finger with 8 trichobothria, *est* slightly distal to *it*, distance *isb*/*ist* 1.13 (1.04-1.28; AR: 1.15) times longer than distance between *ist*/*it* [according to Harvey (1990) trichobothrium *isb* has altered its position in Larcidae, moving to an "abnormal" position between *ist* and *it*; however, here I prefer to use Chamberlin's (1924) traditional terminology, based on trichobothrial positions along the finger, leaving aside the question of post-embryonic changes]; *est* slightly distal *t*; 1 sensilla present in subapical position (Fig. 22); 9 (7-9) chemosensory setae present between trichobothrium *et* and tip finger (drawn and mentioned by Judson & Legg, 1996) (Figs 5, 22); dental line with 40 (35-43) teeth reaching just beyond *esb* or between *esb*-*eb*, distal half with pointed teeth, the rest progressively flattening towards base finger. Movable finger usually with 2 trichobothria (*b* and *t*), but one male with 2 trichobothria on one finger and 3 on the other (*st* added), another male and one female with 3 trichobothria on both fingers (Fig. 21); with 3 sensilla, 1 between trichobothria *b* and *t* (or close to *st*, when third trichobothrium present), 1 distal to *t* and 1 subapical (Fig. 22); with 34 (33/42) teeth reaching proximal trichobothrium *t*, distal half with pointed teeth, basalmost teeth very flattened. Nodus ramosus (Fig. 5) of fixed finger reaching 9th (9/11th) tooth from tip, longer in movable finger, reaching to 11th (11/12th) tooth.

Legs I and IV (length/breadth ratios and measurements in table 1) with arolia undivided and nearly twice as long as claws (Fig. 23). Claws and subterminal seta of telotarsus smooth.

Brief description of nymphs

Deutonymphs with 5 setae on each cheliceral palm. 6 setae on anterior margin of carapace and 2-4 on posterior border. Body length 1.68-1.76 mm. Measurements length/breadth in mm (ratios length/breadth in brackets): carapace 0.44-0.46/0.51-0.55 (0.83-0.85); palp: femur 0.58-0.63/0.13, (4.30-4.96), patella 0.48-0.51/0.14 (3.31-



FIGS 20-23

Larca lucentina sp. n., male paratype, SEM photographs. **20** Dorsal view of hand, patella and femur (partially) of palp. **21** Fingers of chela, lateral view, showing anomalous number of three trichobothria on movable finger. **22** Apex of fingers of chela, lateral view (S = sensilla; c = chemosensory setae, only three of them marked). **23** Apex of leg IV with arolia.

3.52), hand (with pedicel) 0.45-0.50/0.17 (2.59-2.91), finger 0.36-0.37, chela (with pedicel) 0.80-0.84/0.17 (4.60-4.88). Tritonymphs: 5 setae on each cheliceral palm. 7-8 setae on anterior margin of carapace and 2-4 setae on posterior margin. Body length 1.80-2.15 mm. Measurements length/breadth in mm (ratios length/breadth in brackets): carapace 0.48-0.55/0.62-0.65 (0.77-0.88); palp: femur 0.73-0.84/0.15-0.16 (4.97-5.35), patella 0.62-0.69/0.16-0.17 (4.00-4.24), hand (with pedicel): 0.56-0.61/0.17-0.18 (3.04-3.41), finger 0.42-0.46, chela (with pedicel) 0.97-1.02/0.17-0.18 (5.27-5.74).

Tritonymph and deutonymph without epistome (in contrast to *L. lata*, in which the protonymph and deutonymph, but not the later stages, have an epistome: Dumitresco & Orghidan, 1964; Judson & Legg, 1996).

Deutonymphs, with basi- and telotarsus of legs I and II fused, but still showing constriction at joint position (vestige of division, as found in *L. lata* protonymph: Judson & Legg, 1996); posterior legs with weak division between tarsi. Tritonymphs with tarsi partially fused on anterior legs and completely divided on posterior legs.

Etymology

Lucentina is a female inhabitant of *Lucentum*, the Roman name for the provincial capital Alicante.

Remarks

According to Gardini's (1983) key for the genus *Larca*, *L. lucentina* sp. n. can be placed in the group of species with 4 setae on the posterior margin of the carapace. This group includes *L. lata* and *L. hispanica* to which *Larca bosselaersi* Henderickx & Vets, 2002 (from Crete) was later added. It can be seen from the above description that some specimens of the new species have fewer setae on the posterior margin of the carapace: 2 specimens have 2 setae and one specimen has only 1 seta. I have also checked a collection of 48 specimens [15 ♂♂, 16 ♀♀, 16 tritonymphs (T) and 1 deutonymph (D)] from Cova de l'Escaleta, Camarasa, Lérida, Catalonia, Spain, determined by Estany (1980) as *L. hispanica*, of which 14 ♂♂, 11 ♀♀, 10 TT and 1 D possess 4 setae on the posterior margin of carapace, 1 ♂, 3 ♀♀ and 4 TT have 3 setae, and 2 ♀♀ and 2 TT only 2 setae. However, this variation does not change the fact that the four species may be distinguished from other *Larca* species in having a maximum of 4 setae on the posterior margin of carapace, whereas the others have 6 or 8 setae. *Larca italica* Gardini, 1983, the only European species with 7 setae on the posterior margin of the carapace, possesses increased numbers of setae on the rest of the carapace and on the tergites. Based on the arguments that are presented below, it seems plausible that *L. italica* may represent another case of "néochétotaxie majorante" in the sense of Heurtault (1980), Mahnert & Schuster (1981) and Zaragoza (1982), but this needs to be confirmed by the capture and study of nymphal stages.

The second character used by Gardini (1983) for distinguishing species is the number of setae on the cheliceral hand, there are 6 in *L. hispanica*, 5 in *L. lata* and only 4 in *L. bosselaersi* (Henderickx & Vets, 2002). Estany (1980) established that *L. hispanica* possesses 6 setae on the cheliceral hand after having studied a large collection from Cova de l'Escaleta, Camarasa. However, a re-examination of specimens from this cave reveals that 10 ♂♂, 6 ♀♀, 15 TT and 1 D have 5 setae on each chelicera; 4 ♂♂,

9 ♀♀ and 1 T have 5 setae on one chelicera and 6 setae on the other; and only 1 ♂ and 1 ♀ have 6 setae on both chelicerae. M. Judson (in litt.) has observed that one paratype of *L. bosselaersi* (deposited in Muséum National d'Histoire Naturelle, Paris) has 5 setae on one chelicera and 4 on the other. It is evident that the variability seen in the number of cheliceral setae renders this character unreliable for distinguishing species within *Larca*. Moreover, Judson & Legg (1996) noted considerable overlap between the size and proportions of the palps of *L. lata* and *L. hispanica*. It will therefore be necessary to compare other characters in more detail to determinate the validity of these taxa. In a separate article I will present a study of *L.* aff. *hispanica* specimens from new localities in Spain, which will hopefully provide some clarification of this matter.

L. lucentina sp. n. may be easily distinguished from the other *Larca* species by its larger size and more slender articles of the palp. In general, the same applies to the size and proportions of the legs (at least when these are known for other species), with the exception of *Larca fortunata* sp. n., described below. One of the most distinctive characters of *L. lucentina* sp. n. is the ratio between the hand and patella breadth, which in males is only 1.02 (AR) (Figs 2, 3, 20) (some specimens with both articles of the same breadth) and in females 1.13 (AR) (Figs 12, 13). In most other species this ratio is clearly larger, particularly in males. The only species that is similar in this respect is the cave-dwelling *Larca laceyi* Muchmore, 1981, from California, but the dorsal and lateral shape of the palp hand is quite different. As in other species of the genus, *L. lucentina* sp. n. presents marked sexual dimorphism in palp ratios and in the shape of the hand, which must be taken into account when identifying single specimens.

Larca fortunata sp. n. Figs 7-11, 14, 15, 17, 19

Type material: Female holotype and 6 paratypes (2 ♂♂ and 4 ♀♀) from Spain, Murcia Province, Fortuna, Cueva del Solin, collected during the period from 20 September 1984 to 12 January 1985, by Díaz, Lencina & Ortiz. 9 paratypes (5 ♂♂, 3 ♀♀ and 1 tritonymph) collected on 17 June 2003 by J. L. Lencina & V. M. Ortuño. 1 ♂ and 1 ♀ deposited in Muséum d'histoire naturelle de Genève; 1 ♂ and 1 ♀ deposited in Muséum National d'Histoire Naturelle, Paris; holotype and remaining paratypes deposited in the pseudoscorpion collection of Departamento de Ecología de la Universidad de Alicante.

Description of adults

NOTE: Adult paratype data differing from holotype data are given in parentheses.

Opisthosomal pleura and legs yellowish, tergites slightly sclerotized. Carapace and pedipalps brownish. Opisthosoma oval, maximum breadth at tergite VI (some female paratypes have an ovoid shape while others have a more "masculine" appearance, being only moderately ovale).

Carapace (Fig. 7) granulated, without epistome, broader than long. Two pairs of eyes, anterior eyes 0.11 mm (0.08-0.12) from anterior margin, with lens 0.06 mm (0.05-0.07) long and 0.02 mm (0.01-0.03) broad; posterior eyes raised on low tubercle with flattened 0.05 mm (0.04-0.06) long lens. Chaetotaxy: 32 (29-36), 10 (7-9) setae in anterior margin, 12 (12-17) in anterior region, 6 (6-9) in posterior region and 4 (2-4, only one male specimen with 5) on posterior margin. Anterior and lateral setae curved and apically enlarged, the rest simple. Some lyrifissures and glandular pores present as shown in Fig. 7.

Tergal chaetotaxy I-X: 4 : 5 : 7 : 10 : 10 : 10 : 10 : 9 : 10 : T6T (4-5 : 4-7 : 5-8 : 8-10 : 8-10 : 7- 12 : 8-10 : 8-12 : 8-11 : T7-9T), all tergites divided except for tergites I and X undivided, and tergite IX partially divided. Tergites granulated, VIII-X with denticulation. Some lyrifissures aligned with setae. Gland pores of tergites I-X: 0-0 : 2-2 : 2-3 : 4-4 : 4-4 : 4-4 : 4-5 : 3-4 : 4-4 : 3-3 (1-2 : 1-2 : 2-3 : 2-4 : 2-5 : 4-5 : 3-5 : 3-5 : 4-4 : 3-4).

Manducatory process with 3 setae (some specimens with 2 setae on each process, others with 3 on each process); palp coxa with 9-11 setae (9-14), pedal coxae with 6-7 setae on coxa I (6-10), II: 9-10 (6-11), III: 8-10 (6-11), IV: 13-14 (13-19).

Genital opercula of female as shown in Fig. 17, with 14 (10-15) setae on anterior operculum, including two median groups of 4-5 setae, posterior operculum with 11 (10-13) setae; three weakly sclerotized cribriform plates in a transverse row, median plate smaller than lateral ones. Male genital opercula as shown in Fig. 19, with 18-27 setae on anterior and 23-30 on posterior operculum, median setae disposed in two rows; genital opening internally with 1-3+2-3 setae.

Sternite IV partially divided, V-VIII completely divided, IX-X undivided. Chaetotaxy: IV-X: 6 : 7 : 8 : 10 : 10 : 8 : 9 (4-7 : 7-9 : 6-10 : 7-10 : 7-10 : 7-10 : 6-9). Sternite XI bearing 10 (9-13) external and 7 (6-8) internal setae in the desclerotized region surrounding anus. Anal plates with 2+2 setae. Gland pores on sternites V-XI: 2-2 : 3-3 : 3-4 : 3-4 : 3-3 : 2-3 : 21 (1/2 : 2-4 : 3-4 : 3-4 : 3-4 : 2-3 : 16-22). No setae associated with spiracles.

Chelicera (Fig. 8) with 5 setae on the hand and 1 seta on movable finger, the latter 0.83 (0.82-0.87) from base. Galea long, with 4 (3-4) apical rami of unequal length, longer (0.08 mm) in females than in males (0.05 mm) (Fig. 8a). Fixed finger with 2 (2-3) tiny subterminal denticles and 4 (2-5) small teeth; movable finger with 2 rounded subterminal denticles at the level of seta *gs*. Lamina exterior thin. Flagellum with 4 blades, anterior blade with 8 (5-9) spinules, others smooth. Serrula exterior with 15 (15-16) blades. Serrula interior with 10 (9-10) blades, the 3 anterior ones slightly denticulate.

Palp (Figs 9, 10, 11) strongly granulated, except for smooth distal 2/3 of fingers palps. With marked sexual dimorphism, more slender in males (Figs. 14, 15). Ratios and measurements as in Table 2. Trochanter internally with a small subdistal tubercle and 3 micropores. Femur with 3 (2-3) distal micropores. Patella with 3 lyrifissures near pedicel close to a small internal tubercle and 3 (1-4) distal micropores. Hand laterally with 3 micropores at base of finger. Fixed finger with 8 trichobothria, but some adult specimens (5) lacking *ib*, *isb* or *ist*; *est* only slightly distal to *it* (or at the same level or slightly basal), distance *isb*/*ist* 0.91 (0.71-1.04, bigger than 1.00 only found in one specimen; AR: 0.90) times shorter than distance between *ist*/*it*; *est* slightly distal to *t*; one sensilla present in subapical position; 9 (7-9) chemosensory setae present between trichobothrium *et* and tip of finger; dental margin with 37 (36-41) teeth reaching almost to *esb*, teeth pointed along distal third (or half) of finger, the rest rounded and becoming flattened basally to the point of being almost unrecognizable in some specimens. Movable finger with 2 trichobothria, but one male with 3 trichobothria on both fingers; with 3 sensilla, 1 between trichobothria *b* and *t*, 1 distal to *t* and 1 subapical; 36 (35-40) teeth up to trichobothrium *t*, those of distal third (or half) pointed, other teeth

rounded, progressively flattened basally. Nodus ramosus of fixed finger level with 10th (10-12th) distal tooth, that of movable finger longer, reaching 11th (11-14th) distal tooth.

Legs I and IV (length/breadth ratios and measurements in Table 2) with arolia nearly twice as long as claws. Claws and subterminal seta smooth.

Brief description of nymphs

Single tritonymph with 5 setae on each cheliceral palm. 8 setae on anterior margin of carapace and 4 on posterior margin. Body length 2.04 mm. Measurements length/breadth in mm (ratios lenght/breadth in brackets): carapace 0.54/0.62 (0.87); palp: femur 0.76/0.14 (5.43), patella 0.67/0.15 (4.35), hand (with pedicel) 0.57/0.17 (3.29), finger 0.44, chela (with pedicel) 0.99/0.17 (5.66). No epistome on carapace. Tarsi partially fused on the anterior legs and completely divided on posterior legs.

Etymology

The name refers to the town where the species has been collected: Fortuna (fortune).

Remarks

L. fortunata sp. n. is very close to *L. lucentina* sp. n., but differs in the more slender femur and patella of the palp. The length/breadth ratios of these segments do not overlap in males of the two species, whereas this character is less distinctive in females, but in general the palps and legs are more slender in *L. fortunata* sp. n. than in *L. lucentina* sp. n. In *L. fortunata* sp. n. the patella is longer, relative to the other segments, than in *L. lucentina* sp. n., as reflected in the femur/patella and patella/hand ratios. The form of the patella is also different in these species: in *L. lucentina* sp. n. it is markedly convex subapically on the external side, whereas in *L. fortunata* sp. n. it is quite straight. The same is true to a certain extent for the palp femur. Another distinctive character is provided by the chelal hand/patellar breadth ratio: 1.14 in males of *L. fortunata* sp. n. (vs. 1.02 in *L. lucentina* sp. n.) and 1.18 in females (vs. 1.13). Finally, trichobothrium *ist* is closer to *isb* than to *it* in *L. fortunata* sp. n., which is not the case in *L. lucentina* sp. n. where *ist* is closer to *it* than to *isb*.

DISCUSSION

A useful summary of the natural history and habitats of *Larca* species, particularly *L. lata*, is provided by Judson & Legg (1996). Species of this genus are xerophilic, restricted to dry, dusty habitats. *L. lata* is often found in old tree hollows, other species occur in caves. Phoresy on mosquitoes has been observed. *L. lucentina* sp. n. was found in the dry zone of the cave, on the strongly sloping walls of the first hall after the entrance. The walls were covered in dust and the specimens were only recognized by their palps; the rest of the body was hidden under the dust, as if they were waiting for prey to slip on the slope (pers. obs.). The first *L. fortunata* sp. n. specimens were captured using traps baited with cheese or vinegar, the second collection was made by hand in a dry dusty area at the end of the cave. Most of these specimens were found on mustelid droppings, in company with abundant Acari and Collembola which probably form the main prey of this species.

TABLE 1. *Larca lucentina* sp. n.: ratios and measurements. Ratios express how many times an article is longer than broad (unless otherwise noted). Measurements of length/breadth expressed in mm (unless otherwise noted). Abbreviations: L length; B breadth; AR average of ratios; AM average of measurements.

Larca lucentina	**Male holotype**		**Male paratypes** (6 specimens)				**Female paratypes** (6 specimens)			
	Ratio	Measures	Ratio	AR	Measures	AM	Ratio	AR	Measures	AM
Body (L)		2.36			1.99-2.56				2.17-2.50	**2.37**
Carapace	0.84	0.56/0.67	0.79-0.85	**0.82**	0.58-0.61/0.71-0.76	**0.59/0.72**	0.71-0.91	**0.82**	0.54-0.70/0.75-0.83	**0.64/0.77**
Chelicera										
Hand (L)		0.21			0.21				0.21-0.24	**0.23**
Finger (L)		0.13			0.13				0.12-0.14	**0.13**
Pedipalps										
Trochanter	1.97	0.35/0.18	1.96-1.97	**1.97**	0.34-0.36/0.17-0.18	**0.35/0.18**	1.69-1.91	**1.83**	0.34-0.37/0.18-0.19	**0.35/0.19**
Femur	5.77	0.94/0.16	5.40-5.76	**5.65**	0.91-1.01/0.17-0.18	**0.96/0.17**	5.34-5.78	**5.57**	0.99-1.10/0.18-0.20	**1.04/0.19**
Patella	4.49	0.80/0.18	4.19-4.44	**4.33**	0.76-0.81/0.18-0.19	**0.79/0.18**	4.08-4.48	**4.31**	0.78-0.92/0.18-0.21	**0.85/0.20**
Pedicel (L)		0.15			0.14-0.16	**0.15**			0.15-0.19	**0.17**
Hand (with pedicel)	3.98	0.73/0.18	3.49-3.97	**3.77**	0.67-0.73/0.18-0.19	**0.71/0.19**	3.06-3.78	**3.31**	0.72-0.76/0.20-0.24	**0.74/0.22**
Pedicel (L)		0.10			0.07-0.10	**0.09**			0.08-0.10	**0.09**
Finger (L)		0.47			0.45-0.51	**0.48**			0.50-0.53	**0.51**
Chela (with pedicel)	6.38	1.18-0.18	6.10-6.27	**6.23**	1.16-1.19/0.18-0.19	**1.17/0.19**	5.39-5.95	**5.65**	1.19-1.24/0.20-0.23	**1.22/0.22**
Chela/carapace (L/L)	2.11		1.95-2.00	**2.01**			1.89-1.99	**1.93**		
Femur/carapace (L/L)	1.68		1.58-1.66	**1.63**			1.58-1.85	**1.64**		
Femur/finger (L/L)	1.98		1.85-2.04	**1.99**			1.98-2.06	**2.02**		
Femur/patella (L/L)	1.17		1.17-1.26	**1.21**			1.18-1.28	**1.22**		
Patella/hand (L/L)	1.10		1.10-1.18	**1.13**			1.08-1.23	**1.15**		
Hand/patella (B/B)	1.04		1.00-1.05	**1.02**			1.10-1.17	**1.13**		
Hand/finger (L/L)	1.54		1.32-1.58	**1.47**			1.40-1.47	**1.43**		
Leg I										
Femur	3.72	0.34/0.09	3.30-3.57	**3.53**	0.32-0.33/0.09-0.10		3.65-3.89	**3.74**	0.32-0.39/0.09-0.10	**0.36/0.10**
Patella	2.51	0.24/0.10	2.30-2.45	**2.42**	0.24/0.10	**0.24/0.10**	2.31-2.56	**2.45**	0.23-0.28/0.10-0.11	**0.26/0.11**
Tibia	4.14	0.29/0.07	3.67-4.03	**3.92**	0.27-0.28/0.07-0.08	**0.28/0.07**	4.00-4.22	**4.10**	0.27-0.33/0.07-0.08	**0.31/0.08**
Basitarsus	4.15	0.23/0.06	3.91-3.95	**3.98**	0.22/0.06	**0.22/0.06**	3.73-4.21	**4.04**	0.21-0.24/0.06	**0.23/0.06**
Telotarsus	4.01	0.19/0.05	3.89-4.30	**4.07**	0.19-0.20/0.05	**0.19/0.05**	3.35-4.20	**3.93**	0.18-0.21/0.05	**0.20/0.05**
Femur/patella (L/L)	1.37		1.36-1.40	**1.38**			1.33-1.48	**1.39**		
Basitarsus/telotarsus (L/L)	1.19		1.08-1.18	**1.14**			1.11-1.25	**1.19**		
Leg IV										
Femur+patella	5.85	0.72/0.12	5.19-5.52	**5.44**	0.69-0.70/0.13	**0.70/0.13**	5.14-5.48	**5.33**	0.68-0.79/0.12-0.15	**0.74/0.14**
Tibia	6.23	0.51/0.08	5.65-6.05	**5.97**	0.47-0.49/0.08	**0.49/0.08**	5.73-6.24	**5.97**	0.48-0.55/0.08-0.09	**0.52/0.09**
Basitarsus	4.62	0.28/0.06	4.25-4.59	**4.49**	0.26-0.28/0.06	**0.27/0.06**	4.12-4.55	**4.42**	0.28-0.30/0.06-0.07	**0.29/0.07**
Telotarsus	4.78	0.24/0.05	4.56-5.20	**4.82**	0.24-0.26/0.05	**0.25/0.05**	4.19-4.91	**4.64**	0.22-0.27/0.05-0.06	**0.25/0.06**
Basitarsus/telotarsus (L/L)	1.13		1.04-1.14	**1.10**			1.07-1.25	**1.12**		

TABLE 2. *Larca fortunata* sp. n.: ratios and measurements. Ratios express how many times an article is longer than broad (unless otherwise noted). Measurements of length/breadth expressed in mm (unless otherwise noted). Abbreviations: L length; B breadth; AR average of ratios; AM average of measurements.

Larca fortunata	**Female holotype**		**Female paratypes** (5 specimens)				**Male paratypes** (6 specimens)			
	Ratio	Measures	Ratio	AR	Measures	AM	Ratio	AR	Measures	AM
Body (L)		2.66			2.22-2.86	**2.61**			1.86-2.73	**2.38**
Carapace	0.90	0.64/0.71	0.83-1.00	**0.89**	0.58-0.71/0.69-0.83	**0.66/0.74**	0.83-0.95	**0.88**	0.55-0.60/0.60-0.71	**0.58/0.66**
Chelicera									0.21-0.22	
Hand (L)		0.22			0.21-0.25	**0.23**				**0.21**
Finger (L)		0.13			0.12-0.15	**0.13**			0.12-0.13	**0.13**
Pedipalps										
Trochanter	1.83	0.35/0.19	1.81-1.91	**1.86**	0.34-0.39/0.18-0.20	**0.37/0.20**	1.84-2.08	**1.99**	0.33-0.36/0.16-0.19	**0.35/0.18**
Femur	5.97	1.03/0.17	5.59-5.78	**5.74**	1.01-1.13/0.17-0.20	**1.06/0.19**	6.06-6.52	**6.27**	0.96-1.01/0.15-0.16	**0.98/0.16**
Patella	4.62	0.86/0.19	4.36-4.59	**4.51**	0.85-0.95/0.19-0.21	**0.90/0.20**	4.78-5.11	**4.98**	0.80-0.88/0.17-0.18	**0.85/0.17**
Pedicel (L)		0.17			0.16-0.18	**0.17**			0.14-0.16	**0.15**
Hand (with pedicel)	3.28	0.73/0.22	3.08-3.29	**3.18**	0.70-0.78/0.22-0.25	**0.75/0.24**	3.58-3.74	**3.63**	0.69-0.72/0.19-0.20	**0.71/0.19**
Pedicel (L)		0.11			0.11	**0.11**			0.09-0.10	**0.09**
Finger (L)		0.51			0.49-0.54	**0.52**			0.46-0.50	**0.48**
Chela (with pedicel)	5.39	1.20/0.22	5.06-5.37	**5.24**	1.17-1.24/0.22.0.25	**1.22/0.24**	5.85-6.21	**6.00**	1.17-1.18/0.19-0.20	**1.17/0.19**
Chela/carapace (L/L)	1.88		1.80-2.02	**1.93**			1.95-2.11	**2.04**		
Femur/carapace (L/L)	1.61		1.56-1.75	**1.63**			1.65-1.79	**1.70**		
Femur/finger (L/L)	2.03		1.94-2.16	**2.05**			1.94-2.14	**2.03**		
Femur/patella (L/L)	1.20		1.16-1.20	**1.18**			1.12-1.20	**1.15**		
Patella/hand (L/L)	1.18		1.19-1.22	**1.20**			1.16-1.24	**1.21**		
Hand/patella (B/B)	1.19		1.14-1.22	**1.18**			1.12/1.16	**1.14**		
Hand/finger (L/L)	1.43		1.40-1.51	**1.44**			1.43-1.51	**1.46**		
Leg I										
Femur	3.75	0.36/0.10	3.57-3.84	**3.68**	0.33-0.38/0.09-0.11	**0.37/0.10**	3.39-3.94	**3.73**	0.32-0.36/0.08-0.10	**0.34/0.09**
Patella	2.39	0.26/0.11	2.43-2.55	**2.49**	0.25-0.28/0.10-0.11	**0.27/0.11**	2.42-2.65	**2.50**	0.24-0.27/0.10	**0.25/0.10**
Tibia	4.19	0.31/0.07	4.22-4.31	**4.24**	0.30-0.33/0.07-0.08	**0.32/0.08**	3.96-4.50	**4.25**	0.29-0.32/0.07	**0.30/0.07**
Basitarsus	4.21	0.24/0.06	3.91-4.41	**4.18**	0.23-0.25/0.06	**0.24/0.06**	4.11-4.76	**4.40**	0.22-0.25/0.05-0.06	**0.23/0.05**
Telotarsus	4.30	0.22/0.05	4.05-4.33	**4.22**	0.19-0.22/0.05	**0.21/0.05**	3.95-4.49	**4.22**	0.19-0.21/0.05	**0.20/0.05**
Femur/patella (L/L)	1.41		1.34-1.41	**1.37**			1.31-1.41	**1.36**		
Basitarsus/telotarsus (L/L)	1.11		1.07-1.28	**1.16**			1.08-1.23	**1.15**		
Leg IV										
Femur+patella	5.33	0.73/0.14	5.18-5.54	**5.28**	0.71-0.78/0.14-0.15	**0.75/0.14**	5.17-5.92	**5.65**	0.68-0.74/0.12-0.13	**0.70/0.13**
Tibia	6.38	0.54/0.09	5.91-6.43	**6.26**	0.51-0.58/0.09	**0.55/0.09**	5.65-6.84	**6.27**	0.48-0.54/0.08	**0.51/0.08**
Basitarsus	4.59	0.29/0.06	4.29-4.69	**4.52**	0.27-0.31/0.06-0.07	**0.29/0.06**	4.17-5.04	**4.67**	0.26-0.29/0.06	**0.28/0.06**
Telotarsus	5.05	0.28/0.06	4.41-5.00	**4.75**	0.25-0.28/0.05-0.06	**0.27/0.06**	4.90-5.10	**4.99**	0.25-0.27/0.05	**0.25/0.05**
Basitarsus/telotarsus (L/L)	1.03		1.04-1.22	**1.10**			1.05-1.16	**1.09**		

TABLE 3: Femur/carapace length ratio and biology of the known species of *Larca*. Average ratio given for females-males when sex data are known [data from the present study and from: Benedict & Malcolm (1977); Gardini (1983); Henderickx & Vets (2002); Hoff (1961); Judson & Legg (1996); Muchmore (1981); Tooren (2001)].

Larca species	Femur/carapace length	Biology
L. notha	1.20-1.25	Epigean
L. chamberlini	1.39-1.26	Epigean
L. granulata	1.30	Epigean
L. lata	1.50-1.42	Epigean
L. boesselarsi	1.34-1.41	Cave-dwelling
L. italica	1.48	Cave-dwelling
L. hispanica	1.50-1.53	Cave-dwelling
L. laceyi	1.56	Cave-dwelling
L. lucentina	1.64-1.63	Cave-dwelling
L. fortunata	1.63-1.70	Cave-dwelling

In recent years Ranius and his collaborators (Ranius, 2000, 2002; Ranius & Douwes, 2002; Ranius & Wilander, 2000) have been intensively studying the specialized fauna of tree hollows in Sweden. Although their study mainly focuses on the beetle *Osmoderma eremita* Scopoli, other beetles, flies, mites and pseudoscorpions are also considered. Seven pseudoscorpion species have been found in wood mould samples from hollow oaks (Ranius & Wilander, 2000), two of which deserve special attention: *L. lata* and *Allochernes wideri* (C. L. Koch) (Ranius, 2002; Ranius & Douwes, 2002). *A. wideri* occurs on solitary trees with small hollows, while *L. lata* is confined to larger assemblages of very old trees with hollows containing large amounts of wood mould. A genetic studies of both species, at sites situated 400-900 km apart, revealed that in *A. wideri* the genetic differentiation between populations was low but significant, whereas in *L. lata* it did not deviate significantly from zero for mainland populations and only became significant when an island population was taken into account. The authors concluded that migration rates are high for *L. lata*, probably due to phoresy, although this has only occasionally been observed.

Considering the fact that five of the six *Larca* species known from Europe (including the two new species described here) bear four setae or less on the posterior margin of their carapace, it seems reasonable to suppose that they are derived from a common ancestor similar to *L. lata*, since this is the only epigean species in Europe and the least evolved taxon of this group.

L. lata has been reported from Austria, the Czech Republic, Denmark, England, Germany, Poland, Rumania, Sweden (Judson & Legg, 1996), Latvia (Tumss, 1934) and the Netherlands (Tooren, 2001), but it seems to be absent from the Mediterranean region. The dependence on old tree hollows observed for *L. lata* suggests that in colder ages, during the Quaternary period, the genus was probably more widespread in Europe, accompanying the expansion of forests. During the last warmer interglacial period, the forest mass declined in the Mediterranean regions due to climatic changes and to management. This is very marked in the south-eastern region of Spain that is considered arid or semiarid zone and where the new taxa are present. Populations of *Larca* would consequently have disappeared from these areas or else subsisted in cave

refugia, which provided the most similar habitat to the tree hollows in terms of constant temperature and humidity, with dusty floor and dry guano from bats or other vertebrates. It is possible that the fauna inhabiting this niche, including potential prey such as Acari, Collembola and Psocoptera, may be similar to that found in tree hollows populated by *L. lata*, but this remains to be confirmed. The greater distance between the caves inhabited by the surviving populations, compared to that between the trees in a forest, would have reduced or eliminated genetic exchange via phoresy on mosquitoes: these insects can be found at the entrances of caves, but rarely inside. The resulting isolation and adaptation to the new habitat would have given rise to new taxa with troglomorphic adaptations.

Cave adaptation is seen in some characters of *Larca* but not in others. Both pairs of eyes seem to be functional in all known species, but in the cave species the lenses are more flattened. Some general desclerotization is visible in the cave taxa, but the best indicators of adaptation to cave life are the elongated palps. The ratio femur/carapace length [used by Gardini (1983) to separate the North America species in his key] indicates quite well the degree of troglomorphic adaptation (Table 3), according to which *L. lucentina* sp. n. and *L. fortunata* sp. n. are the species with most pronounced adaptation for a cavernicolous way of life.

The presence of two trichobothria on the movable finger of the chela is typical for the genus *Larca*, except that the epigean species *Larca notha* Hoff, 1961, has three trichobothria and no variation has been reported for this species (Muchmore, 1981). Gardini (1983), citing Vachon (1947), writes about "neotenia localizzata" where the number of trichobothria in deutonymphs persist in tritonymphs and adults, but in this genus this phenomenon is limited to the movable finger only. The variation observed in both new species, which includes some specimens with three trichobothria, may be the result of neoteny too, which is quite frequent in other Arthropoda with adaptation to cave life (Galan & Herrera, 1998). Therefore the neotenia retention of three trichobothria on the movable finger of the chelae is possibly another morphological adaptation to a cave-dwelling life.

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